

1      **CLAIMS:**

2      1. A semiconductor processing apparatus for applying a coating  
3      to a semiconductor wafer, substrate, flat panel displays, data disk,  
4      microelectronic component, thin film head for hard disk drive, or other  
5      semiconductor article being coated, comprising:

6              a spray processing vessel;

7              a wafer support, for holding a wafer or other semiconductor  
8      article being coated;

9              a spray-head mounted within the spray processing vessel for  
10     directing a spray of coating upon a wafer or other article held in the  
11     wafer support; said spray-head being movable relative to the processing  
12     chamber and relative to the wafer support to allow the spray-head to  
13     be directed onto different areas of a wafer held in the wafer support.

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15      2. An apparatus according to claim 1 and further comprising:

16              a gas conduit for delivering carrier gas to the spray-head;

17              a coating conduit for delivering coating to the spray-head.

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19      3. An apparatus according to claim 1 and further comprising:

20              a gas conduit for delivering carrier gas to the spray-head;

21              a coating conduit for delivering coating to the spray-head;

22              a coating metering pump for delivering a precise quantity of  
23      coating to the spray-head.

1           4. The apparatus of claim 1 and further comprising a gas  
2           driven ultrasonic nozzle on the spray-head.

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4           5. An apparatus according to claim 1 and further comprising:  
5           a gas conduit for delivering carrier gas to the spray-head;  
6           a coating conduit for delivering coating to the spray-head;  
7           a coating metering pump for delivering a precise quantity of  
8           coating to the spray-head;  
9           an ultrasonic nozzle on the spray-head; said ultrasonic nozzle  
10          being connected to the gas and coating conduits.

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12          6. An apparatus according to claim 1 and further comprising:  
13          a gas conduit for delivering carrier gas to the spray-head;  
14          a coating conduit for delivering coating to the spray-head;  
15          an ultrasonic nozzle on the spray-head; said ultrasonic nozzle  
16          being connected to the gas and coating conduits.

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18          7. An apparatus according to claim 1 and further comprising  
19          a coating viscosity control for controlling the viscosity of coating applied  
20          by said spray-head.

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22          8. An apparatus according to claim 1 and further comprising  
23          a coating viscosity control for controlling the viscosity of coating applied  
24          by said spray-head; said coating viscosity control including a heater.

1           9. An apparatus according to claim 1 and further comprising  
2           a heater for heating the coating delivered through the spray-head.

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4           10. An apparatus according to claim 1 and further comprising  
5           a spray-head heater for heating the spray-head.

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7           11. An apparatus according to claim 1 and further comprising  
8           a gas heater for heating carrier gas delivered to the spray-head.

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10          12. An apparatus according to claim 1 and further comprising:  
11           a gas conduit for delivering carrier gas to the spray-head;  
12           a coating conduit for delivering coating to the spray-head;  
13           a heater for heating the coating delivered through the spray-head.

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15          13. An apparatus according to claim 1 and further comprising:  
16           a gas conduit for delivering carrier gas to the spray-head;  
17           a coating conduit for delivering coating to the spray-head;  
18           a heater for heating the coating delivered through the spray-head;  
19           a coating metering pump for delivering a precise quantity of  
20           coating to the spray-head.

1           14. An apparatus according to claim 1 and further comprising:  
2           a gas conduit for delivering carrier gas to the spray-head;  
3           a coating conduit for delivering coating to the spray-head;  
4           a heater for heating the coating delivered through the spray-head;  
5           a coating metering pump for delivering a precise quantity of  
6           coating to the spray-head;  
7           an ultrasonic nozzle on the spray-head; said ultrasonic nozzle  
8           being connected to the gas and coating conduits.

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10          15. An apparatus according to claim 1 and further comprising  
11          a coating metering pump.

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13          16. An apparatus according to claim 1 wherein the wafer  
14          support is mounted for rotation within the spray processing vessel such  
15          that the wafer or other item to be coated can be controllably rotated.

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17          17. An apparatus according to claim 1 wherein the spray-head  
18          is movable relative to the processing chamber so that the spray-head  
19          can moved pivotally relative to a wafer held in the wafer support.

1           18. An apparatus according to claim 1 wherein the spray-head  
2           is axial movable relative to the processing chamber to allow extension  
3           and retraction of the spray-head toward and away from the surface of  
4           a wafer being coated; said spray-head also being pivotal relative to a  
5           wafer held in the wafer support.

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7           19. An apparatus according to claim 1 wherein the spray-head  
8           is axial movable to allow extension and retraction of the spray-head  
9           toward and away from the surface of a wafer being coated.

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1           20. A semiconductor processing apparatus for applying a coating  
2        to a semiconductor wafer, substrate, flat panel display, data disk,  
3        microelectronic component, thin film head for hard disk drive, or other  
4        semiconductor article to be coated, comprising:

5           a frame;

6           a spray processing vessel mounted upon said frame;

7           a wafer support, for holding a wafer or other item to be coated;

8           a spray-head mounted within the spray processing vessel for  
9        directing a spray of coating upon a wafer or other article held in the  
10      wafer support; said spray-head being movable relative to the processing  
11      chamber and relative to the wafer support to allow the spray-head to  
12      be directed onto different areas of a wafer held in the wafer support;

13           a gas conduit for delivering carrier gas to the spray-head;

14           a coating conduit for delivering coating to the spray-head;

15           a coating metering pump for delivering a precise quantity of  
16      coating to the spray-head;

17           a coating viscosity control for controlling viscosity of coating  
18      applied by said spray-head.

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20           21. An apparatus according to claim 20 and further comprising  
21      an ultrasonic nozzle on the spray-head.

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23           24. An apparatus according to claim 20 wherein the coating  
24      viscosity control includes a heater.

1           23. An apparatus according to claim 20 and further comprising  
2           a spray-head heater for heating the spray-head.

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4           24. An apparatus according to claim 20 and further comprising  
5           a gas heater for heating carrier gas delivered to the spray-head.

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7           25. An apparatus according to claim 20 and further comprising:  
8           a heater for heating the coating delivered through the spray-head;  
9           an ultrasonic nozzle on the spray-head; said ultrasonic nozzle  
10          being connected to the gas and coating conduits.

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12          26. An apparatus according to claim 20 wherein the wafer  
13          support is mounted for rotation within the spray processing vessel such  
14          that the wafer or other item to be coated can be controllably rotated.

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16          27. An apparatus according to claim 20 wherein the spray-head  
17          is movable relative to the processing chamber so that the spray-head  
18          can be moved pivotally relative to a wafer held in the wafer support.

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20          28. An apparatus according to claim 20 wherein the spray-head  
21          is axially movable relative to the processing chamber to allow extension  
22          and retraction of the spray-head toward and away from the surface of  
23          a wafer being coated; said spray-head also being pivotal relative to a  
24          wafer held in the wafer support.

1           29. An apparatus according to claim 20 wherein the spray-head  
2           is axially movable to allow extension and retraction of the spray-head  
3           toward and away from the surface of a wafer being coated.

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1           30. A semiconductor processing apparatus for applying a coating  
2 to a semiconductor wafer, substrate, flat panel display, data disk,  
3 microelectronic component, thin film head for hard disk drive, or other  
4 semiconductor article to be coated, comprising:

5           a frame;  
6           a spray processing vessel;  
7           a wafer support, for holding a wafer or other item to be coated;  
8           a spray-head mounted within the spray processing vessel for  
9 directing a spray of coating upon a wafer or other article held in the  
10 wafer support; said spray-head being movable relative to the processing  
11 chamber and relative to the wafer support to allow the spray-head to  
12 be directed onto different areas of a wafer held in the wafer support;  
13           a wafer transfer for moving wafers relative to the wafer support;  
14           a thermal treatment station for thermally treating wafers coated  
15 in the spray processing vessel.

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17           31. An apparatus according to claim 30 wherein the spray  
18 processing vessel, wafer support, wafer transfer, and thermal treatment  
19 station are substantially enclosed within an outer processing enclosure.

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21           32. An apparatus according to claim 30 wherein the thermal  
22 treatment station includes at least one contact heater against which a  
23 wafer is controllably contacted.

1           33. An apparatus according to claim 30 and further comprising  
2           at least one wafer inventory station for holding being wafers for access  
3           by said wafer transfer.

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5           34. An apparatus according to claim 30 and further comprising  
6           a coating viscosity control.

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8           35. An apparatus according to claim 30 and further comprising  
9           a heater for heating the coating delivered through the spray-head.

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11          36. An apparatus according to claim 30 and further comprising  
12          a spray-head heater for heating the spray-head.

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14          37. An apparatus according to claim 30 and further comprising  
15          a gas heater for heating carrier gas delivered to the spray-head.

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17          38. An apparatus according to claim 30 and further comprising  
18          a coating metering pump for delivering a precise quantity of coating to  
19          the spray-head.

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21          39. An apparatus according to claim 30 wherein the wafer  
22          support is mounted for rotation within the spray processing vessel such  
23          that the wafer or other item to be coated can be controllably rotated.

1           40. An apparatus according to claim 30 wherein the spray-head  
2 is movable relative to the processing chamber so that the spray-head  
3 can moved pivotally relative to a wafer held in the wafer support.

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5           41. An apparatus according to claim 30 wherein the spray-head  
6 is axially movable relative to the processing chamber to allow extension  
7 and retraction of the spray-head toward and away from the surface of  
8 a wafer being coated; said spray-head also being movable relative to the  
9 processing chamber so that the spray-head can moved pivotally relative  
10 to a wafer held in the wafer support.

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12           42. An apparatus according to claim 30 wherein the spray-head  
13 is axially movable to allow extension and retraction of the spray-head  
14 toward and away from the surface of a wafer being coated.

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1           43. A semiconductor processing method for applying a coating  
2       layer to a semiconductor wafer, substrate, flat panel display, data disk,  
3       microelectronic component, thin film head for hard disk drive, or other  
4       semiconductor articles, comprising:

5       positioning a wafer within a spray processing vessel;  
6       spraying a liquid coating through a spray-head to provide a  
7       coating spray which is directed at an area of the wafer that is to be  
8       coated to form a wafer coating;

9       moving the spray head during said spraying step.

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11       44. A method according to claim 43 and further comprising  
12       pivotally moving the spray-head relative to the wafer to be coated.

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14       45. A method according to claim 43 and further comprising  
15       metering the liquid coating to provide precise flow rate of coating.

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17       46. A method according to claim 43 and further comprising  
18       controlling the viscosity of the coating spray.

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20       47. A method according to claim 43 wherein said spraying the  
21       liquid is performed by forcing the liquid through a spray-head nozzle  
22       with a carrier gas.

1           48. A method according to claim 43 and further comprising  
2           spraying the liquid by forcing the liquid through a spray-head with  
3           nozzle with a carrier gas so as to generate sonic vibrations which help  
4           to atomize the liquid as it emits from the spray-head.

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6           49. A method according to claim 43 and further comprising  
7           controlling the viscosity of the coating spray by heating the spray-head.

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9           50. A method according to claim 43 and further comprising:  
10           spraying the liquid by forcing the liquid through a spray-  
11           head nozzle with a carrier gas.

12           controlling the viscosity of the coating spray by heating the  
13           carrier gas.

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15           51. A method according to claim 43 further comprising:  
16           transferring a wafer which has been coated to a thermal treatment  
17           station;  
18           thermally treating the wafer using the thermal treatment station.

1           52. A method according to claim 43 wherein said positioning  
2 includes transferring a wafer from an inventory station to the spray  
3 processing vessel;

4           and further comprising:

5           transferring a wafer which has been coated in said spraying  
6 step to a thermal treatment station;

7           thermally treating the wafer to cure said wafer coating.

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9           53. A method according to claim 43 wherein said positioning  
10 includes transferring a wafer from an inventory station to the spray  
11 processing vessel;

12           and further comprising:

13           transferring a wafer which has been coated in said spraying  
14 step to a thermal treatment station;

15           thermally treating the wafer to cure said wafer coating;

16           and wherein said positioning, spraying, moving, transferring, and  
17 thermally treating are carried out within an outer processing enclosure.